United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
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September 27, 2019

Andrew D. Kelly, Colonel
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Service Consultation Code:	04EF2000-2019-F-0553
Corps Application Number:	SAJ-2014-03670 (SP-KRD)
Date Received:	February 20, 2019
Consultation Initiation Date:	May 10, 2019
Project:	Sanibel Causeway Island B Shoreline Stabilization
Applicant:	Lee County
County:	Lee

Dear Colonel Kelly:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion to the U.S. Army Corps of Engineers' (Corps) for groin construction, upgrades to a stormwater management system and the placement of sand along 1.15 miles (mi) of Sanibel Causeway Island B shoreline in Lee County, Florida (Project). The Corps determined that the Project may affect, and is likely to adversely affect the threatened North Atlantic Distinct Population Segment (DPS) of the green sea turtle (*Chelonia mydas*), the endangered hawksbill sea turtle (*Eretmochelys imbricata*), the endangered leatherback sea turtle (*Dermochelys coriacea*), the endangered Kemp's ridley sea turtle (*Lepidochelys kempii*), and the threatened Northwest Atlantic Ocean Distinct Population Segment (NWAO DPS) of the loggerhead sea turtle (*Caretta caretta*); and may affect, but is not likely to adversely affect the threatened piping plover (*Charadrius melodus*), the threatened red knot (*Calidris canutus rufa*), the threatened West Indian manatee (*Trichechus manatus*; manatee) and manatee designated critical habitat. For the purposes of this document, the five identified sea turtles will be referred to collectively as sea turtles. This document is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beaches and NOAA Fisheries has jurisdiction for sea turtles in the marine environment. Our analysis in this Biological Opinion will only address activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. Please note the provisions of this consultation do not apply to sea turtles in the

marine environment, such as swimming juvenile and adult sea turtles or loggerhead critical habitat in the marine environment. If applicable, you are required to consult with the NOAA Fisheries on this Project. For further information on Act compliance with the NOAA Fisheries, please contact Karla Reece, Acting Chief of the Interagency Cooperation Brach, by e-mail at karla.reece@noaa.gov or by phone at 727-209-5953.

This Biological Opinion is based on information provided in the Corps' February 20, 2019, letter, the Corps' January 10, 2019, public notice and additional correspondences with the Corps. A complete record of this consultation is on file at the South Florida Ecological Services Office in Vero Beach, Florida.

Consultation History

On February 20, 2019, the Service received a copy of the Corps' letter dated February 20, 2019, and public notice dated January 10, 2019, requesting initiation of informal consultation on the proposed Project in Lee County, Florida.

On May 10, 2019, the Service requested the Corps make a may effect, and is likely to adversely affect determination for nesting sea turtles.

On May 10, 2019, the Corps changed their determination to may effect, and is likely to adversely affect nesting sea turtles.

On May 10, 2019, the Service completed their review of the proposed Project and initiated formal consultation with the Corps concerning the potential effects of the Project on sea turtles, piping plovers, red knots, and manatees.

BIOLOGICAL OPINION

This Biological Opinion provides the Service's opinion as to whether the proposed Project is likely to jeopardize the continued existence of sea turtles. There is no designated critical habitat for the piping plover in the Project area; therefore, this Biological Opinion will not address destruction or adverse modification of piping plover critical habitat.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY

Jeopardy Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly. to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this Biological Opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of species; (3) the Effects of the Action, which determine the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) the Cumulative Effects, which evaluate the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the species, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

DESCRIPTION OF PROPOSED ACTION

Lee County (Applicant) proposes to construct beach stabilization and stormwater management structures on approximately 1.15 mi of shoreline along the San Carlos Bay and Pine Island Sound shorelines of Sanibel Causeway Island B, located near Fort Myers, Lee County, Florida (Figure 1). Along the San Carlos Bay shoreline (east shoreline), the Applicant proposes to construct nine new low-profile t-head groins totaling 16,553 square feet (sq ft) (0.38 acre [ac]), two new segmented onshore breakwaters (essentially t-groins without stems) totaling 520 sq ft (0.01 ac), and add a 4 linear foot (LF) extension to an existing terminal groin located at the southeast end of the island. Groins G1 through G4 will be approximately 95 ft in length with t-heads 60 ft in width, groins G5 through G9 will be approximately 50 ft in length with t-heads 42 ft in width, and the breakwaters are 20 ft in width (Figure 2). Groins G5 through G9 and the two breakwaters have been reduced in size to avoid encroachment to nearby seagrass beds and will maintain a 10-ft buffer to all seagrass. The distance between t-groins ranges from 80 ft to 110 ft and generally corresponds to their length, with shorter distances between shorter groins. Approximately 5,000 cubic yards (CY) of sand will be placed between the t-groins and continue to the southeastern terminal groin (Figure 3). Additionally, 200 LF of existing riprap revetment at the northeast end of the island will be repaired and enhanced by constructing a single layer overlay of nominally 1,200-pound limestone boulders (Figure 4). Along the Pine Island Sound shoreline (west shoreline), the Applicant proposes to construct two low-profile terminal groins adjacent to the bridge abutments (20 LF at the southwest end of the island and 98 LF at the northwest end of the island) (Figure 5) and place approximately 3,700 CY of sand along the shoreline between the terminal groins.

All Project groins will be constructed of nominally 1,200-pound limestone boulders to a maximum crest elevation of +5.0 ft North America Vertical Datum (NAVD) and terminate at a water depth of approximately -4 ft NAVD or less. Existing limestone riprap revetment along the San Carlos Bay shoreline between G-1 and G-7 will be excavated, sorted and reused as foundation material for new groins. An existing parking area on the east side of the island will be used as a staging area and revetment sorting site. Sand specified for use will be derived from

an upland mine and is the coarsest sand (0.72 mm) readily available in the proximity of the Project. The coarseness of the sand and the limited volume will prevent beach profile equilibration into the adjacent seagrass beds.

The Project also includes stormwater management improvements to reduce the volume of runoff from existing impervious areas. Approximately 1400 ft of newly constructed roadside swales will drain to five new outfalls. One existing outfall on the Pine Island Sound shoreline that currently terminates flush with the beach face above the MHWL will be repaired and extended. All outfalls will discharge offshore at an elevation just below the MLWL, with all sections below the MHWL stabilized with an open pile and crib framework (Figure 6). Outfall termini will maintain at least a 10-ft buffer from seagrass beds. To reduce the potential for seabed scour and sediment transport toward seagrass beds, all outfall termini will be fitted with a T-pipe that will both reduce the velocity and redirect the discharge in an alongshore direction (Figure 6). Appropriate grating will be fitted over the ends of the T-pipes to prevent manatee entrapment.

Overall, the Project will result in the discharge 14,500 CY of fill material below the plane of the mean high water line (MHWL) over approximately 4.8 ac of non-vegetated subaqueous bottom. All structures will be constructed in shallow water depths of less than 3 ft below the mean low water line (MLWL) to avoid impacts to all existing seagrass beds. Silt curtains will be utilized during construction to avoid turbidity and sediment movement over seagrass.

All Project components will be constructed during daylight hours using land-based equipment with no in-water operations conducted from barges. The Applicant plans to begin Project construction around January 2020 and complete the Project by September 2020.

Minimization and Conservation Measures

The Applicant has agreed to follow and implement the Reasonable and Prudent Measures (RPMs) and the Terms and Conditions identified in the *Statewide Programmatic Biological Opinion* (2015-SPBO; Service 2015) that apply to only the sand placement portion of the Project concerning sea turtles. In addition, the Applicant will implement the Conservation Measures for non-optimal piping plover habitat as outlined in the *Programmatic Piping Plover Biological Opinion* (P^3BO; Service 2013).

To minimize impacts to manatees from the proposed Project, the Applicant has agreed to follow and implement the Florida Fish and Wildlife Conservation Commission's (FWC) *Standard Manatee Conditions for In-Water Work* (FWC 2011), and the minimization measures outlined for manatees in the 2015-SPBO.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action. The Service identifies the action area to include the sand fill template; staging, discharge, and stockpile areas; beach access corridors; upland sand mine; and groin template. The Project is located along the Gulf of Mexico, Lee County, Florida (latitude: 26.46736 and longitude: - 82.02998).

SPECIES NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

Piping plover

The Service has determined the Project's impact to non-optimal piping plover habitat is consistent with the analysis in the P[3]BO. As previously stated, the Applicant has agreed to follow and implement the Conservation Measures outlined in the P[3]BO that apply to the Project. As it relates to survey guidelines defined in P[3]BO Conservation Measure #2, the Service approves a reduction in the survey effort, and the following revised survey guidelines can be implemented by the Applicant:

1. One pre-construction winter shorebird survey will be conducted within a 10-day timeframe beginning the first Friday in February, as outlined in the Florida Shorebird Alliance's Winter Shorebird Survey (http://flshorebirdalliance.org/media/1164/2019-winter-shorebird-survey-final-instructions.pdf). If the February pre-construction survey is not possible, two preconstruction winter shorebird surveys will be conducted as close as possible to the February dates and at least 15 days apart, and reported to the FWC and the Service. Pre-construction surveys will not be conducted between May 16 and July 14. If piping plovers are documented during the preconstruction survey, the Service will be contacted for potential implementation of additional conservation measures prior to construction commencement. In addition, a February winter shorebird survey will be conducted as outlined above, for 2 years post-construction. All shorebird survey data will be forwarded to the Service annually upon completion.
2. The person(s) conducting the surveys must demonstrate the qualifications and ability to identify shorebird species and be able to provide the information outlined in the Winter Shorebird Survey.

Based on implementation of the P[3]BO's proposed Conservation Measures and that the Project is located in non-optimal piping plover habitat, the Service concurs with the Corps' determination that the Project may affect, but is not likely to adversely affect the species; therefore, the piping plover will not be considered further in this Biological Opinion. A report must be submitted by July 31 of each year in which monitoring is completed, as described in Term and Condition 9 of the P[3]BO.

Red knot

Red knots may use the Project area during winter and migration periods. In Florida, red knots are commonly found along sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments, mangrove and brackish lagoons. Red knots forage along sandy beaches during spring and fall migration throughout Florida. To date, critical habitat has not been proposed or designated for the red knot. Based on our Geographic Information System database and eBird (2019), no red knots have been documented in the action area. Because suitable habitat for the red knot and piping plover is similar, minimization measures for potential

effects to red knots in non-optimal habitat will be incorporated into the Project through the Applicant's implementation of the Conservation Measures to reduce impacts on piping plovers for projects located in non-optimal piping plover habitat as outlined in the P^3BO.

Based on implementation of the P^3BO's proposed Conservation Measures and that the Project is located in non-optimal red knot habitat, the Service concurs with the Corps' determination that the Project may affect, but is not likely to adversely affect the species; therefore, the red knot will not be considered further in this Biological Opinion.

West Indian manatee

The Project occurs within the geographic range of the manatee and is located in designated critical habitat for the species. The Applicant has agreed to follow and implement the *Standard Manatee Conditions for In-Water Work* (FWC 2011) and the minimization measures outlined for manatees in the 2015-SPBO to avoid potential effects to manatees. Based on the proposed protection measures, the Service concurs with the Corps' determination that the Project may affect, but is not likely to adversely affect the species and its critical habitat; therefore, the manatee will not be considered further in this Biological Opinion.

STATUS OF THE SPECIES/CRITICAL HABITAT

Sea turtles (sand placement portion of the Project only)

The Project is located in sea turtle nesting habitat, and therefore could adversely affect nesting sea turtles, their nests, and hatchlings. The purpose of the Project is to stabilize the shoreline in order to protect infrastructure and property, offset the sediment deficit, and address shoreline erosion.

The Service has determined the Project's effects concerning sand placement activities are consistent with those analyzed in the 2015-SPBO. Therefore, it is appropriate to apply the 2015-SPBO to the Project. Based on the Applicant's commitment to implement the minimization measures, RPMs, and the Terms and Conditions identified in the 2015-SPBO that apply to the Project, the Project's take coverage for listed sea turtles is henceforth covered under the 2015-SPBO.

Sea Turtles (groin construction)

Please see the 2015-SPBO (Service 2015) for the current Status of the Species for sea turtles, at: https://www.fws.gov/verobeach/SFESO/images/biologicalopinion/20150313_BO_Sand_Placement_Statewide_final.pdf.

Summary of threats to the species

Sea turtles face a variety of natural and anthropogenic threats in the Project area. Natural threats include: predation; erosion, tidal inundation, and sand accretion; and hurricanes. Anthropogenic threats may include: beach re-nourishment; coastal development and shoreline armoring;

disorientation caused by artificial lighting; human presence on the beach; in-water alterations; motor vehicles; and recreational beach use.

Natural threats

Predation

Predation of sea turtle eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern U.S. are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), and fire ants (*Solenopsis invicta*) (Dodd 1988; Stancyk 1995). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977; Hopkins and Murphy 1980; Stancyk et al. 1980; Talbert et al. 1980; Schroeder 1981; Labisky et al. 1986).

Erosion, tidal inundation, and sand accretion

Erosion, tidal inundation, and sand accretion are the major biotic factors impacting incubating sea turtle eggs (NOAA Fisheries and Service 2008). Short-term erosion events caused by seasonal storms are a natural occurrence throughout the State of Florida where the number of storm-related activity varies on a yearly basis. Sea turtles deposit several clutches each nesting season and distribute their nests temporally and spatially, which reduces the probability of the entire season's reproductive effort being lost to a single storm event. Chronic shoreline erosion along the coastline can result in reduced nesting habitat resulting in an adverse effect on sea turtle survival.

The entire shoreline within the Project area is considered to be subject to chronic erosion. Over time, eroded areas are subject to inundation.

Inundation can affect sea turtle nests in two ways:

1. Wash Over: This occurs when waves wash over the top of the nest, but do not expose the egg chamber. Such events can modify the incubation environment (increased moisture, change in temperature, modified gas exchange), thereby reducing reproductive success. Nests not washed out by tidal inundation are extremely susceptible to embryonic mortality due to the eggs becoming saturated with seawater (Bustard and Greenham 1968; Milton et al. 1994; Martin 1996).
2. Wash Out: This occurs when the egg chamber is fully exposed and inundated by sea water. Inundation can result in total nest loss (total washout) or partial nest loss (partial washout). In these situations embryo survival is not likely, thereby reducing reproductive success of the inundated nest.

Under average conditions, nests near the water's edge are in danger of failure or reduced reproductive success due to wash over and wash out. Nests located high on the beach can be similarly impacted by unusually high tides or surge. Sea turtle nests are most commonly

impacted by inundation on severely eroded beaches and/or during storm events resulting in higher than normal tides and/or surge.

During major storm events, large sand shifts may occur, causing sand to accrete over incubating nests. This increased depth of sand over the nest can modify the temperature, moisture level, and respiratory gas exchange in the nest. If the nest is near hatching, the increased depth of sand may cause the hatchlings to suffocate or become exhausted as they attempt to emerge from the nest in order to reach the ocean. This sand displacement can result in an increased risk of predation on land and in the ocean.

Hurricanes

Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain, which can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct loss of sea turtle nests either by erosion or washing away of the nests by wave action and inundation or "drowning" of the eggs or pre-emergent hatchlings within the nest, or indirectly by causing the loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). The manner in which hurricanes affect sea turtle nesting also depends on the characteristics of each storm (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat in a natural state with no immediate development landward of the sandy beach, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of pre-development coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become reestablished after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a loss of nesting habitat.

Anthropogenic threats

Beach re-nourishment

Beach nourishment is a common remedy for erosion along Florida's barrier island shorelines (Pilkey et al. 1984). Shoreline stabilization, protection of property, and increased recreational area are often the goals of beach nourishment projects. Beach nourishment generally involves dredging of sand from inlets or offshore borrow sites and placement on an eroded section of

coastline. Inland sand sources may also be used and the sand deposited from the landward side of the beach. Sand placement seaward of the MHWL is regulated by the Corps and the State's Joint Coastal Permitting program. Sand placement landward of the MHWL, from inland sources, is governed by the State's Coastal Construction Control Line (CCCL) program.

Several studies have shown that beach nourishment may result in providing otherwise unavailable nesting habitat (Witham 1990; Lebuff and Haverfield 1992; Crain et al. 1995). Some studies have found nourished beaches to be less suitable for turtle nesting than natural beaches (Mann 1977; Raymond 1984). Nourishment can alter a beach's slope, shear resistance, sand characteristics (including compaction), and moisture content (Nelson and Dickerson 1988). Changes in these characteristics can impact nest site selection, digging behavior, reproductive success, and hatchling emergence (Raymond 1984; Nelson and Dickerson 1988; Burney and Mattison 1992; Brock 2000). A study by Rumbold et al. (2001) found that a nourished beach monitored for 3 years pre-construction and 2 years post-construction received less than normal nesting by loggerhead sea turtles in the first year post-nourishment, but that nesting frequency appeared to return to pre-nourishment values in the second season. Despite this increase, the study suggested the value of the nourished beach for nesting was negatively affected.

Nourished beaches tend to be wider, flatter, and more compact than natural beaches and their sediments have higher moisture content and increased temperature (Nelson et al. 1987; Ackerman et al. 1991; Byrd 2004). Coastal processes immediately following nourishment can result in the formation of a steep scarp on the beach as the beach profile equilibrates to its natural slope. This scarp can prevent nesting females from ascending the beach and may result in abandonment of nesting or a nest being deposited below the scarp, making it more susceptible to inundation. As the beach reaches its post-construction equilibrium, the slope becomes milder, making it more ideal for nesting. Sediments on a nourished beach tend to be more compact than those on natural beaches, inhibiting nest construction. Placing beach compatible sand on nourished beaches is critical to maintaining an optimum incubation environment for sea turtle eggs. Incompatible sand can alter the moisture content, gas exchange, and temperature of the incubation environment (Ackerman et al. 1991; Ackerman 1997).

Coastal development and shoreline armoring

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development not only causes the loss of suitable nesting habitat, but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration (NRC 1990b). This may in turn cause the need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment, all of which cause changes in, additional loss of, or impact to the remaining sea turtle habitat.

Coastal construction activities can cause direct and indirect impacts to sea turtles and their habitat by altering the dune ecosystem. The greatest threat from coastal construction is damage to and reduction in nesting habitat (Lutcavage et al. 1997). Direct impacts occur during construction and are generally attributed to the permanent loss or alteration of habitat, while indirect impacts occur post-construction. Coastal construction activities include but are not

limited to the following:

1. Construction and/or maintenance of upland commercial structures, residential structures, and ancillary structures.
2. Construction of dune cross-overs.
3. Construction of seawalls, geotextile container systems, and other armoring structures.
4. Installation and maintenance of utilities.
5. Sand fences.
6. Construction of stormwater outfalls.

Impacts to sea turtles resulting from coastal development include the loss of sea turtle nesting habitat, alternation of coastal process (*e.g.*, wave reflection from vertical seawalls will likely result in increased erosion at and downdrift of the seawall), and imprudent construction practices such as the excavation of the primary dune or the importation of non-beach compatible sand. Such construction practices are less likely to occur in recent years in Florida as the Florida Department of Environmental Protection (DEP) strictly regulates these practices through their CCCL program. The use of vertical seawalls on the coast is sometimes unavoidable to protect older homes, which are oftentimes sited significantly seaward and at considerably lower elevations than newer homes permitted through the CCCL program.

Impacts of coastal development on sea turtle nesting activities can be reduced in various ways including, but not limited to, requiring these activities occur outside of nesting season, be constructed as far landward as practical and not result in excavation of the primary dune, use beach compatible material, and adhere to all regulations regarding beach furniture and artificial lighting. All construction seaward of the State's CCCL requires a DEP permit that incorporates measures for the protection of sea turtles.

Disorientation caused by artificial lighting

Artificial lights along a beach can deter females from coming ashore to nest or misdirect females trying to return to the surf after a nesting event. Artificial beachfront lighting is also a documented cause of hatchling disorientation (loss of bearings) and misorientation (incorrect orientation) on nesting beaches (Philibosian 1976; Mann 1977; Witherington and Martin 1996). Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Dickerson and Nelson 1989; Witherington and Bjorndal 1991). The emergence from the nest and crawl to the sea is one of the most critical periods of a sea turtle's life. Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators, or become dehydrated and may never reach the sea. In addition, research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). Lighting associated with condominiums had the greatest impact on disorientation/misorientation on Florida beaches; other causes included street lights, single family homes, parking lots and city glow (Nelson et al. 2002).

Human presence on the beach

Human presence on the beach at night may disturb and deter a female from nesting, especially if flashlights are being used (McFarlane 1963). A female may abandon nesting up until the time

she begins laying eggs. It is unknown what the long term effects of this may be, but repeated interruption may cause her to nest in a sub-optimum environment (Murphy 1985). Once disturbed, the female may abandon nesting and attempt to nest in a different location, at a different time, or abort her clutch at sea.

Disturbing hatchlings on the beach, although typically out of curiosity and with good intentions, can have negative impacts on the imprinting ability of the hatchling (LeBuff 1990). This will affect the adult female turtle's ability to return to their natal beach when it is time to nest. Human footprints may interfere with a hatchling's ability to reach the ocean (Hosier et al. 1981). These footprints can create impressions in the sand that are difficult for hatchlings to crawl over and may disorient the hatchlings.

In-water alterations

Groins are shore-perpendicular structures that are designed to trap sand that would otherwise be transported by longshore currents and can cause downdrift erosion (Kaufman and Pilkey 1979). Project breakwaters are similar to t-head groins but the "groin" stems are not present, leaving only the breakwater heads. These structures have profound effects on adjacent beaches (Kaufman and Pilkey 1979).

Following construction, the presence of groins and breakwaters may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation. In addition to decreasing nesting habitat suitability, construction or repair of groins and breakwaters during the nesting season may result in the destruction of nests, disturbance of females attempting to nest, and disorientation of emerging hatchlings from Project lighting.

Motor vehicles

The operation of motor vehicles on the beach can affect sea turtle nesting by interrupting or striking a female turtle on the beach, headlights disorienting or misorienting emergent hatchlings, vehicles running over hatchlings attempting to reach the ocean, and vehicle tracks traversing the beach that interfere with hatchlings crawling to the ocean. Hatchlings appear to become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier et al. 1981). Driving on the beach can cause sand compaction which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing pre-emergent hatchlings (Mann 1977; Nelson and Dickerson 1987; Nelson 1988).

The physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit

plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. Vehicular traffic through dune breaches or low dunes on an eroding beach may cause an accelerated rate of overwash and beach erosion (Godfrey et al. 1978). If driving is necessary, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly reestablish provided the mechanical impact is removed.

The public is not permitted to operate motorized vehicles on Lee County beaches. Public safety and emergency vehicles occasionally access the beach for emergency purposes. Maintenance vehicles on the beach are only necessary after extreme, episodic events such as tropical storms. Maintenance or emergency vehicles present on the beach during nesting season may run over turtle nests, compacting the sand above them. The presence of vehicles on the beach at night may result in direct take of adult and hatchling sea turtles. Vehicles leave deep ruts in the sand and cause emerging hatchlings to become trapped or disoriented when attempting to reach the ocean. Most vehicles permitted on Lee County beaches are all terrain vehicles (ATVs). These ATVs are lightweight and outfitted with low pressure tires, thereby reducing the impact they could have on unmarked turtle nests. Such ATVs are used for daily sea turtle patrols on some portions of the Project area, traveling close to the MHWL so as not to impact any sea turtle nests.

Recreational beach use

Human presence on or adjacent to the beach at night during the nesting season, particularly recreational activities, can reduce the quality of nesting habitat by deterring or disturbing nesting turtles and causing them to avoid otherwise suitable habitat. In addition, human foot traffic can make a beach less suitable for nesting and hatchling emergence by increasing sand compaction and creating obstacles to hatchlings attempting to reach the ocean (Hosier et al. 1981).

The use and storage of lounge chairs, cabanas, umbrellas, catamarans, and other types of recreational equipment on the beach at night can also make otherwise suitable nesting habitat unsuitable by hampering or deterring nesting adult females and trapping or impeding hatchlings during their nest to sea migration. The documentation of non-nesting emergences (also referred to as false crawls) at these obstacles is becoming increasingly common as more recreational beach equipment is left on the beach at night. Sobel (2002) describes nesting turtles being deterred by wooden lounge chairs that prevented access to the upper beach. Nesting sea turtles that encounter obstacles on the beach at night, such as beach chairs, cabanas, umbrellas, jet skis, volleyball nets, boats, and motorized vehicles, may become disoriented or may abandon a nesting attempt, resulting in a false crawl/non-nesting emergence. False crawls result in usage of energy without the reproductive success demonstrated in a successful nesting attempt. Turtles encountering obstacles may also choose to nest in less suitable sites.

There is increasing popularity in the southeastern U.S, especially in Florida, for beach communities to carry out beach cleaning operations to improve the appearance of beaches for visitors and residents. Beach cleaning occurs on private beaches and on some municipal or county beaches that are used for nesting by loggerhead sea turtles. Beach cleaning activities effectively remove "seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood,

and virtually any unwanted debris" (Barber and Sons 2012). Removal of wrack material (organic material that is washed up onto the beach by surf, tides, and wind) reduces the natural sand-trapping abilities of beaches and contributes to their destabilization. As beach cleaning vehicles and equipment move over the sand, sand is displaced downward, lowering the substrate. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Neal et al. 2007). In addition, since the beach cleaning vehicles and equipment also inhibit plant growth and open the area to wind erosion, the beach and dunes may become unstable. Beach cleaning "can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion" (Defeo et al. 2009). This is also a concern because dunes and vegetation play an important role in minimizing the impacts of artificial beachfront lighting by creating a barrier that prevents residential and commercial business lighting from being visible on the beach.

ENVIRONMENTAL BASELINE

Status of the species within the action area

Sea Turtles

The proposed Project is located within the Peninsular Florida Recovery Unit (PFRU). The PFRU averages 83,011 nests per year (based on 2011-2015 nesting data). Of the available nesting habitat within the PFRU, the proposed groin construction will occur on 0.07 ac of available nesting beach along 1,130 ft (0.21 mi) of shoreline. Project action area beaches currently provide limited nesting habitat because (1) approximately 800 ft (0.15 mi) of the shoreline is armored with revetment, and (2) vehicle parking extends to the MHWL in most areas with sandy beaches. No ongoing sea turtle nesting surveys are conducted on Project area shorelines, and while no successful nesting has been documented on the island, false crawls have been noted (Mongiovi 2019). Because Project activities will result in sand accretion, totals listed below for nesting occurrences are from taken from data collected on the nearby Sanibel Island beach (East), located 1.2 mi south of the Project area.

Green sea turtle

Of the counties along the west coast of Florida, Lee County supported the third highest nesting of green sea turtles with 9 nests (0.2 nests per mi) in 2018 (FWC 2019a). In 2018, there was one non-nesting event by a green sea turtle in Lee County. No occurrences of green sea turtle nesting or false crawls were documented along the 5.2 mi of the Sanibel Island (East) shoreline during 2018.

Hawksbill sea turtle

No occurrences of hawksbill sea turtle nesting have been documented in the Project area. The majority of nesting surveys conducted in Florida occur during the morning hours and are based on interpretation of the tracks left by the turtles as they ascend and descend the beach; the turtles themselves are rarely observed. Because hawksbill sea turtle tracks are difficult to discern from loggerhead sea turtle tracks, it is likely that nesting by hawksbill sea turtles is underreported

(Meylan et al. 1995).

Kemp's ridley sea turtles

No occurrences of Kemp's ridley sea turtle nesting have been documented in the Project area. The majority of nesting surveys conducted in Florida occur during the morning hours and are based on interpretation of the tracks left by the turtles as they ascend and descend the beach; the turtles themselves are rarely observed. Because Kemp's ridley sea turtle tracks are difficult to discern from loggerhead sea turtle tracks, it is likely that nesting by Kemp's ridley sea turtles is underreported (Meylan et al. 1995).

Leatherback sea turtle

No occurrences of leatherback sea turtle nesting were documented in Lee County during 2018 (FWC 2019a). Leatherback sea turtles nests or false crawls have been documented as far back as 1994 in Lee County, with the most recent nest occurring in 2015 (FWC 2019b).

Loggerhead sea turtle

Of the counties along the west coast of Florida, Lee County supported the second highest nesting of loggerhead sea turtles, with 2,059 nests (46 nests per mi) in 2018 (FWC 2019a). In 2018, loggerhead sea turtles made 45,526 false crawls in Lee County. Along the 5.2 mi of the Sanibel Island (East) shoreline, loggerhead sea turtles laid 104 nests and made 230 false crawls in 2018.

Climate change

Our analyses under the Act include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel on Climate Change (IPCC), "climate" refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time; thus "climate change" refers to a change in such a measure which persists for an extended period, typically decades or longer, due to natural conditions (e.g., solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450). Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC (2014 and citations therein). Information for the United States at national and regional levels is summarized in the National Climate Assessment (Melillo *et al.* 2014 entire and citations therein; see Melillo *et al.* 2014, pp.28-45 for an overview). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it. (See Melillo *et al.* 2014, Appendix 3, pp. 760-763 for a discussion of climate modeling, including downscaling). In our analysis, we use our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

Along developed coastlines, and especially in areas where shoreline protection structures, such as seawalls or revetments have been constructed to limit shoreline movement, rising sea levels will cause severe effects on nesting sea turtle females and their eggs. These structures can result in the permanent loss of dry nesting beach or deter nesting females from reaching suitable nesting sites (National Research Council [NRC] 1990a), and nesting females may deposit eggs seaward of such structures potentially subjecting them to repeated tidal inundation or washout by waves and tidal action.

EFFECTS OF THE ACTION

Adverse effects

Sea turtles

Entrapment/physical obstruction

The use of heavy machinery on beaches during Project construction may have adverse effects on sea turtles. Equipment left on the nesting beach overnight can create barriers to nesting females emerging from the surf and crawling up the beach, causing a higher incidence of false crawls and unnecessary energy expenditure.

In addition, following construction, the presence of the low-profile groins has the potential to adversely affect sea turtles. The groins may interfere with the egress and ingress of adult females at nesting sites; alter downdrift beach profiles through erosion, escarpment formation, and loss of berms; trap or obstruct hatchlings during a critical life-history stage; increase hatchling and adult female energy expenditure in attempts to overcome the structures; and attract additional predatory fish and/or birds or concentrate existing predatory fish and/or birds, thereby increasing the potential of hatchling predation. The first hour of a hatchling's life is precarious and predation is high, but threats decrease as hatchlings distance themselves from their natal beaches (Stancyk 1995; Pilcher et al. 2000). Delays in hatchling migration (both on the beach and in the water) can cause added expenditures of energy and an increase of time spent in predator rich nearshore waters. On rare occasions hatchlings will encounter natural nearshore features that are similar to the emergent structures proposed for this Project. However, observations of hatchling behavior during an encounter with a sand bar at low tide, a natural shore-parallel barrier, showed the hatchlings maintained their shore-perpendicular path seaward, by crawling over the sand bar versus deviating from this path to swim around the sand bar through the trough, an easier alternative.

Missed nests

Potential adverse effects during the construction of the low-profile groins include disturbance of existing nests which may have been missed by surveyors and thus not relocated or marked for avoidance, disturbance of females attempting to nest, and disorientation of emerging hatchlings. Although a nesting survey and nest marking program would reduce the potential for nests to be impacted by construction activities, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, and/or tides) or misidentified as false crawls during daily patrols.

Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

Nest relocation

There is a potential for eggs to be damaged by their movement, particularly if eggs are not relocated within 12 hours of deposition (Limpus et al. 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success, and hatchling emergence (Limpus et al. 1979; Ackerman 1980; Parmenter 1980; Spotila et al. 1983; McGehee 1990). Relocating nests into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings.

Nest moisture content is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard et al. 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard et al. 1985), hatchling size (Packard et al. 1981; McGehee 1990), energy reserves in the yolk at hatching (Packard et al. 1988), and locomotory ability of hatchlings (Miller et al. 1987). In a 1994 Florida study comparing loggerhead hatching and emergence success of relocated nests with *in situ* nests, Moody (1998) found hatching success was lower in relocated nests at 9 of 12 beaches evaluated and emergence success was lower in relocated nests at 10 of 12 beaches surveyed in 1993 and 1994.

The presence of the low-profile groins may alter the natural coastal processes and result in an unnatural beach profile, which could negatively impact sea turtles regardless of construction timing. The use of heavy machinery can cause sand compaction (Nelson et al. 1987; Nelson and Dickerson 1988). Significant reductions in nesting success (*i.e.*, false crawls occurred more frequently) have been documented on severely compacted beaches (Fletemeyer 1980; Raymond 1984; Nelson and Dickerson 1987; Nelson et al. 1987), and increased false crawls may result in increased physiological stress to nesting females.

Erosion control structure breakdown

If the low-profile groins fail and break apart, they may spread debris on the beach, which may further impede nesting females from accessing suitable nesting sites (resulting in a higher incidence of false crawls) and trap hatchlings and nesting turtles (NOAA Fisheries and Service 1991, 1992, 1993).

Escarpment formation

Escarpments may develop on beaches as it equilibrates to its final profile based on the effects of the low-profile groins. Escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998) and can cause adult females to choose unsuitable nesting areas, such as seaward of an escarpment. These nest sites commonly receive prolonged tidal inundation and erosion, which results in nest failure.

Future sand migration and erosion

Groins are shore-perpendicular structures that are designed to trap sand that would otherwise be transported by longshore currents (Kaufman and Pilkey 1979; Komar 1983). In preventing normal sand transport, these structures accrete updrift beaches while causing accelerated beach erosion downdrift of the structures (Komar 1983; Pilkey et al. 1984; NRC 1987), a process that results in degradation of sea turtle nesting habitat. As sand fills the area updrift from the groins, some littoral drift and sand deposition on adjacent downdrift beaches may occur due to spillover. However, these groins often force the stream of sand into deeper offshore water where it is lost from the system (Kaufman and Pilkey 1979). The greatest changes in beach profile near groins are observed close to the structures, but effects eventually may extend many miles along the coast (Komar 1983).

Erosion control structures (*e.g.*, terminal groins, t-groins, and breakwaters), in conjunction with beach nourishment, can help stabilize U.S. Gulf and Atlantic coast barrier island beaches (Leonard et al. 1990). However, groins often result in accelerated beach erosion downdrift of the structures (Komar 1983; NRC 1987) and corresponding degradation of suitable sea turtle nesting habitat (NOAA Fisheries and Service 1991, 1992). Initially, the greatest changes are observed close to the structures, but effects may eventually extend significant distances along the coast (Komar 1983).

Conventional groins operate by blocking the natural longshore transport of littoral drift (Kaufman and Pilkey 1979; Komar 1983). Conventional rubble mound groins control erosion by trapping sand and dissipating some wave energy. In general, except for terminal groins at the downdrift limit of a littoral cell, groins are not considered favorable erosion control alternatives because they usually impart stability to the updrift beach and transfer erosion to the downdrift side of the structure. In addition, groins deflect longshore currents offshore, and excess sand builds up on the updrift side of the structure which may be carried offshore by those currents. This aggravates downdrift erosion and erosion escarpments are common on the downdrift side of groins (Humiston and Moore 2001).

Beneficial effects

Groins constructed in appropriate high-erosive areas where the natural accretion of sand is disrupted as a result of altered coastal processes, or to offset the effects of shoreline armoring, may reestablish a beach where none currently exists, stabilize the beach in rapidly eroding areas and reduce the potential for escarpment formation, reduce destruction of nests from erosion, and reduce the need for future sand placement events by extending the interval between sand placement events. However, caution should be exercised to avoid automatically assuming the reestablishment of a beach will wholly benefit sea turtle populations without determining the extent of the low-profile groins and breakwaters effect on nesting and hatchling sea turtle behavior.

Interrelated and interdependent actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that does not have

independent utility apart from the action under consultation. The construction of the proposed low-profile groins is an interrelated activity as it relates to the entire Project. No interdependent actions are expected to result from the Project.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. The Service is not aware of any specific activities that would be considered cumulative effects.

CONCLUSION

After reviewing the current status of the sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's Biological Opinion that the construction of the low-profile groins and breakwaters, as proposed, is not likely to jeopardize the continued existence of the sea turtles. We have reached this conclusion because: (1) groin and breakwater construction will directly impact 0.07 ac of potential nesting shoreline; (2) long-term adverse effects to adult and hatchling sea turtles are anticipated along approximately 1,130 ft (0.21 mi) of the approximately 1,400 mi of available sea turtle nesting habitat in the southeastern U.S. as a result of the presence of the low-profile groins and breakwaters; and (3) the permanent placement of the nine low-profile groins and two breakwaters is expected to affect nesting, hatching, and hatchling emerging success along 1,130 ft (0.21 mi) of shoreline for the life of the erosion control structures.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided such taking is in compliance with the terms and conditions of this incidental take statement.

The terms and conditions described below are nondiscretionary and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to the Applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps: (1) fails to assume

and implement the terms and conditions; or (2) fails to require the Applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Sections 7(b)(4) and 7 (o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service anticipates incidental take of sea turtles will be difficult to detect and quantify for the following reasons: (1) the turtles nest primarily at night and all nests are not found because [a] natural factors, such as rainfall, wind, and tides may obscure crawls and [b] human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and nest mark and avoidance program; (2) the total number of hatchlings per undiscovered nest is unknown; (3) an unknown number of females may avoid the Project beach and be forced to nest in a less than optimal area; (4) an unknown number of adult and hatchling sea turtles may be obstructed or entrapped during ingress or egress at nesting sites; and (5) escarpments may form and prevent an unknown number of females from accessing a suitable nesting site. Therefore, the Service has chosen to use acreage and length of shoreline as a surrogate for incidental take.

The Service determined that incidental take will be associated with the long-term effects of the nine low-profile groins and two breakwaters along approximately 1,130 ft (0.21 mi) of shoreline, and placement of the groins and breakwaters on 0.07 ac of shoreline. The Service determined no more than the following types of incidental take will result from the proposed action:

1. Destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and nest mark and avoidance program within the boundaries of the proposed nine low-profile groins and two breakwaters.
2. Harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities.
3. Misdirection of nesting sea turtles or hatchling turtles on beaches within the boundaries of the proposed Project or beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of increased sand accretion due to the presence of the nine low-profile groins and two breakwaters.
4. Behavior modification of nesting females due to escarpment formation, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs.

5. Reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site.
6. Destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service.
7. Behavior modification of nesting females or hatchlings due to the presence of the nine low-profile groins and two breakwaters, which may act as a barrier to movement or cause disorientation of turtles while on the nesting beach.
8. Behavior modification of nesting females if they dig above a buried portion of the low-profile groins, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas.
9. Obstruction or physical entrapment of an unknown number of adult and hatchling sea turtles during ingress or egress at nesting sites, due to the low-profile groins.

Incidental take is anticipated for the one-time construction of nine low-profile groins and two breakwaters along approximately 1,130 ft (0.21 mi) of shoreline, placement of the groins on 0.07 ac of shoreline, loss of sea turtles due to missed nests and/or relocations during Project construction, and groin and breakwater related entrapment and physical obstruction.

EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined that this level of expected take is not likely to result in jeopardy to sea turtles.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give RPMs it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with, to implement the RPMs. The Service believes the following RPMs are necessary and appropriate to minimize effects of the proposed Project on sea turtles:

1. All derelict material or other debris must be removed from the beach prior to any construction.
2. During nesting season (April 20 through November 23) and until the last nest hatches within and adjacent to the action area, land-based construction activities must be conducted during daylight hours to avoid encountering nesting females and emerging hatchling sea turtles.
3. Daily early morning surveys for nesting sea turtles must be conducted.
4. During nesting season (April 20 through November 23) and until the last nest hatches within and adjacent to the action area, construction equipment and materials must be stored in a manner that will minimize impacts to sea turtles to the maximum extent practicable.
5. No permanent exterior lighting will be installed in association with the proposed groins and breakwaters.
6. During nesting season (April 20 through November 23), a barrier shall be installed around the perimeter of the groin and breakwater construction area sufficient to prevent adult and hatchling sea turtles from accessing the construction area.

7. All excavations and temporary alteration of beach topography during construction activities will be filled or leveled to the natural beach profile prior to 9:00 p.m. each day.
8. If any nesting turtles are sighted on the beach within the Project area during daylight hours, all land-based construction activities must cease immediately until the turtle has returned to the water.
9. Predator-proof trash receptacles must be installed and maintained at all beach access points used for Project construction to minimize the potential for attracting sea turtle predators.
10. A meeting between representatives of the Corps, Applicant, contractor, Service, FWC, the permitted sea turtle surveyor, and other species surveyors, as appropriate, must be held prior to the commencement of construction activities.
11. Visual surveys for escarpments along the Project area must be made following completion of construction and prior to April 15 for 3 subsequent years. Escarpment formation must be monitored and leveling conducted if needed to reduce the likelihood of impacting nesting and hatchling sea turtles.
12. Daily nesting surveys must be conducted by the Applicant for 3 nesting seasons following construction.
13. A report describing the fate of the nests and hatchlings must be submitted to the Service following completion of the proposed Project for each year when the activity has occurred.
14. In the event the groins or breakwaters begin to disintegrate, all debris and structural material must be removed.
15. Post-construction survey(s) of all artificial lighting visible from the adjacent beach must be completed to determine if sand accretion caused by the groins or breakwaters, created an increased impact due to artificial lighting within the vicinity of the Project area due to an increase in shoreline elevation.
16. The groins and/or breakwaters must be removed or modified if they are determined to not be effective.
17. The FWC sea turtle permit holder must be notified if a sea turtle nest is excavated.
18. If nests are laid in areas where they may be affected by groin and breakwater construction activities, nests must be relocated.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which carry out the RPMs, described above and outline required reporting/monitoring requirements. These Terms and Conditions are non-discretionary.

1. All derelict concrete, metal, and other debris must be removed from the beach prior to any construction to the maximum extent possible. If debris removal activities take place during the sea turtle nesting season, the work must be conducted during daylight hours only and must not commence until completion of the sea turtle nesting survey each day. Prior consultation with the Service for this work must occur, to assess impacts to other federally protected species such as beach mice and migratory birds.
2. Outside of nesting season (November 24 through April 19) and until the last nest hatches within and adjacent to the Project area, land-based construction activities may take place

during the daylight and nighttime hours. Should the Applicant choose to work in the nesting season (April 20 and November 23), land-based construction activities shall only occur during daylight hours to avoid encountering nesting females and emerging hatchling sea turtles.

3. Daily early morning surveys for sea turtle nests will be required if any land-based construction activities occur during nesting season (April 20 through November 23). No land-based construction activity may commence until completion of the sea turtle nesting survey each day. If nests are constructed in the area of the groins or breakwaters, the nests must be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation. Nesting surveys must be initiated 65 days prior to groin and breakwater construction activities or April 15, whichever is later. Nesting surveys must continue through the end of the Project or through November 24. If nests are constructed in areas where they may be affected by land-based construction activities, the nests must be relocated as follows:
    a. Nesting surveys and nest relocations shall only be conducted by personnel with prior experience and training in nesting survey and nest relocation procedures. Surveyors must have a valid FWC permit. Nesting surveys must be conducted daily between sunrise and 9:00 a.m. Nests shall be relocated during the early morning nesting surveys.
4. Staging areas for all land-based construction equipment would be located as landward as possible and barricaded on all four sides using sheets of plywood during the nesting season (April 20 through November 23) and until the last nest hatches within and adjacent to the Project area, in order to minimize disturbance to sea turtle nesting and hatching activities.
5. No permanent exterior lighting will be installed in association with this Project. Temporary lighting of the construction area during the sea turtle nesting season (April 20 through November 23) shall be reduced to the minimum standard required by the Occupational Safety and Health Administration (OSHA) for general construction areas. Lighting on all equipment including offshore equipment shall be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, Corps EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment shall be reduced to the minimum standard required by OSHA for general construction areas, in order not to misdirect sea turtles. Shields shall be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area and to the adjacent sea turtle nesting beach. The Applicant's lighting management plan must be reviewed and approved by the Service prior to the beginning of the Project.
6. During nesting season (April 20 through November 23) and until the last nest hatches within and adjacent to the Project area, a barrier (*e.g.*, hay bales, silt screens, chain link fencing) sufficient to prevent adult and hatchling sea turtles from accessing the construction site, shall be installed creating a 100-ft buffer around the perimeter of the site. The barrier shall be placed parallel to shore at the MHWL, as close to the groins and breakwaters as feasible during the period from sunset to sunrise.
7. All excavations and temporary alteration of beach topography for all land-based construction will be filled or leveled to the natural beach profile prior to 9:00 p.m. each

day. During any periods when excavated trenches must remain on the beach at night, nighttime sea turtle monitoring by the sea turtle permit holder will be required in the Project area in order to further reduce possible impacts to nesting and hatchling sea turtles. Nighttime monitors will record data on false crawls, successful nesting, and any additional activities of nesting or hatchling sea turtles in the Project area.

8. If any nesting turtles are sighted on the beach during daylight hours, land-based construction activities must cease immediately until the turtle has returned to the water, and the sea turtle permit holder responsible for nest monitoring has marked any nest that may have been laid for avoidance.
9. Predator-proof trash receptacles must be installed and maintained during construction at all beach access points used for Project construction to minimize the potential for attracting sea turtle predators. The contractors conducting the work must provide predator-proof trash receptacles for the construction workers. All contractors and their employees must be briefed on the importance of not littering and keeping the Project area trash and debris free.
10. A meeting between representatives of the Applicant, Corps, contractor, Service, FWC, permitted sea turtle surveyor, and other species surveyors, as appropriate, must be held prior to the commencement of construction activities. At least 10 business days advance notice must be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the sea turtle protection measures, as well as additional guidelines when construction occurs during the sea turtle nesting season (April 20 through November 23). At that meeting the Corps must provide the Service with specific information on the actual Project that is going to proceed (form on the following web link: <http://www.fws.gov/northflorida/SeaTurtles/Docs/Corp%20of%20Engineers%20Sea%20Turtle%20Permit%20Information.pdf> and emailed to the Service at seaturtle@fws.gov.
11. Visual surveys for escarpments along the Project must be made immediately after completion of construction and within 30 days prior to April 15 for 3 subsequent years. Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 ft must be leveled and the beach profile reconfigured to minimize scarp formation. Any escarpment removal must be reported by location. If the Project is completed during the portion of the nesting season (April 20 through November 23), escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. The Service must be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 ft occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined escarpment leveling is required, the Service or FWC will provide a brief written authorization within 30 days that describes methods to be used to reduce the likelihood of impacting existing nests. An annual summary of escarpment surveys and actions taken must be submitted to the South Florida Ecological Services Office.
12. Daily nesting surveys must be conducted for 3 nesting seasons post-construction. The survey area must be divided into two segments: Project area and Downdrift Zone. The parameters outlined in Appendix A shall be recorded for each crawl encountered on a daily survey. In addition, any obstructions (natural or man-made) encountered by the

turtle and the turtle's response to that obstruction must be reported. This information will be provided to the South Florida Ecological Services Office within 3 months of the year following the end of the nesting season, and will be used to periodically assess the cumulative effects of these projects on sea turtle nesting and hatchling production and monitor suitability for nesting

13. A report with the information listed in Tables 1 and 2 must be submitted to the Service electronically (seaturtle@fws.gov) and to the South Florida Ecological Services Office by December 31, after completion of groin and breakwater construction.
14. In the event the groins or breakwaters begin to disintegrate, all debris and structural material must be removed from the nesting beach area and deposited off site immediately upon coordination with the Service. If removal of the structure is required during the period from April 20 to November 23, no work will be initiated without prior coordination with the Service and the FWC.
15. A post-construction survey(s) of all artificial lighting visible from the adjacent beach (100 ft on either side of the groins or breakwaters) must be completed by the Applicant. Two surveys must be conducted of all lighting visible from the construction area by the Applicant, using standard techniques for such a survey (Appendix B), in the year following construction. The first survey must be conducted between May 1 and May 15, and a brief summary provided to the South Florida Ecological Services Office. The second survey must be conducted between July 15 and August 1. A summary report of the surveys must be submitted to the South Florida Ecological Services Office within
16. 3 months after the last survey is conducted. Include the following information in the summary report: methodology of the survey, a map showing the position of the lights visible from the beach, a description of each light source visible from the beach, recommendations for remediation, and any actions taken. After the annual report is completed, a meeting must be set up with the Applicant, FWC, Corps, and Service to discuss the survey report, as well as any documented sea turtle disorientations in or adjacent to the Project area. If the Project is completed during the nesting season (April 20 through November 23) and prior to May 1, the contractor may conduct the lighting surveys during the year of construction.
17. The groins and/or breakwaters must be removed or modified if they are determined not to be effective and/or causing significant adverse impacts to the beach and dune system.
18. In the event a sea turtle nest is excavated during construction activities, the FWC sea turtle permit holder responsible for egg relocation for the Project must be notified so the eggs can be removed to a designated relocation site.
19. Nest relocation would only commence when FWC has specifically authorized nest within the groin and breakwater template.

MONITORING AND REPORTING REQUIREMENTS

Pursuant to 50 CFR § 402.14(i)(3), the Corps must provide adequate monitoring and reporting to determine if the amount or extent of take is approached or exceeded.

A report describing the actions taken to implement the terms and conditions of this incidental take statement must be submitted to the FWC, Imperiled Species Management Section, Tallahassee office and the Service's South Florida Ecological Services Office, Vero Beach,

Florida within 60 days post-construction. This report would include the dates of actual construction activities, names and qualifications of personnel involved in nest surveys and relocation activities, descriptions and locations of self-release beach sites, nest survey and relocation results, hatching success of nests, and post-construction lighting survey results. All reports would be submitted electronically to the Corps, FWC, and the Service on standard electronic media (e.g., compact disc).

DISPOSITION OF DEAD OR INJURED SPECIMENS

Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office: (20501 Independence Blvd., Groveland, Florida 34736; 352-429-1037). Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission: FWC Office: South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002). Care should be taken in handling sick or injured specimens to ensure effective treatment and in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens, or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following:

1. To increase public awareness of sea turtles, educational signs should be placed where appropriate at beach access points explaining the importance of the area to sea turtles and/or the life history of sea turtle species that nest in the area.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the conservation recommendation(s) carried out.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. As written in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Corps involvement or control over the action has been retained (or is authorized by law) and if:

1. 0.07 ac of shoreline along 1,130 ft (0.21 mi) of beach for construction of the nine low-profile groins and two breakwaters of incidental take is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Biological Opinion;

3. The Corps action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Biological Opinion; and
4. A new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation and effort in protecting federally listed species and fish and wildlife resources. If you have any questions regarding this project, please contact Dennis Hamlin at 772-469-4225.

Sincerely yours,

Acting for Roxanna Hinzman
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Tampa, Florida (Katy Damico)
DEP, Tallahassee, Florida (Lainie Edwards)
EPA, West Palm Beach, Florida (Ron Miedema)
FWC, Tallahassee, Florida (FWC-CPS, Robbin Trindell, Kristen Nelson-Sella)
NOAA Fisheries, St. Petersburg, Florida (Mark Sramek, Dennis Klemm)
NOAA Fisheries, West Palm Beach, Florida (Jocelyn Karazsia)
Service, St. Petersburg, Florida (Ann Marie Lauritsen)

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Table 1. Information to be submitted to the Service electronically (seaturtle@fws.gov) and to the South Florida Ecological Services Office by December 31, after completion of construction.

All projects	Project location (include DEP reference monuments and latitude and longitude coordinates)
	Project description (include linear feet of beach, actual fill template, access points, and borrow areas)
	Dates of actual construction activities
	Names and qualifications of personnel involved in sea turtle nesting surveys and relocation activities (separate the nest surveys for nourished and non-nourished areas).
	Descriptions and locations of sites where nests were relocated.

Table 2. Information to be submitted to the Service electronically (seaturtle@fws.gov) and to the South Florida Ecological Services Office by December 31, concerning sea turtle nests 100 ft on either side of the terminal groins after completion of construction.

Date	Duration	Variable	Criterion
Nesting Success	Year of in season construction, two years post construction if placed sand remains on beach and variable does not meet criterion based on previous year	Number of nests and non-nesting events	40% or greater (a statistically valid number of loggerhead and green nests, and all leatherback nests)
Hatching success	Year of in season construction and one year post construction if placed sand remains on beach and variable does not meet success criterion based on previous year	Number of hatchlings by species to hatch from egg	60% or greater (a statistically valid number of loggerhead and green nests, and all leatherback nests)

Emergence Success	Year of in-season construction and one year post construction if placed sand remains on beach and variable does not meet success criterion based on previous year	Number of hatchlings by species to emerge from nest onto beach	80% or greater (a statistically valid number of loggerhead and green nests, and all leatherback nests)
Disorientations	Year of in-season construction and two years post construction if placed sand remains on the beach	Number of nests and individuals that misorient or disorient	https://myfwc.com/media/18147/fwc-disorientation-report-form.pdf
Lighting Surveys	Two surveys the year following construction, one survey between May 1 and May 15 and second survey between July 15 and August 1	Number, location and photographs of lights visible from nourished berm, corrective actions and notifications made	Lighting survey and meeting resulting with plan for reduction in lights visible from nourished berm within one to two month period
Compaction	Three seasons following construction. Not required if the beach is tilled prior to nesting season each year placed sand remains on beach	Shear resistance	Less than 500 psi
Escarpment Surveys	Weekly during nesting season for three years each year placed sand remains on the beach	Number of scarps 18 inches or greater extending for more than 100 feet that persist for more than 2 weeks	Successful remediation of all persistent scarps as needed

* If nesting and reproductive (hatching and emergence) success is less than the criteria listed above, the Corps and the Service shall review and discuss the Groin Maintenance Plan during the annual meeting to determine if groin modification or removal is necessary.

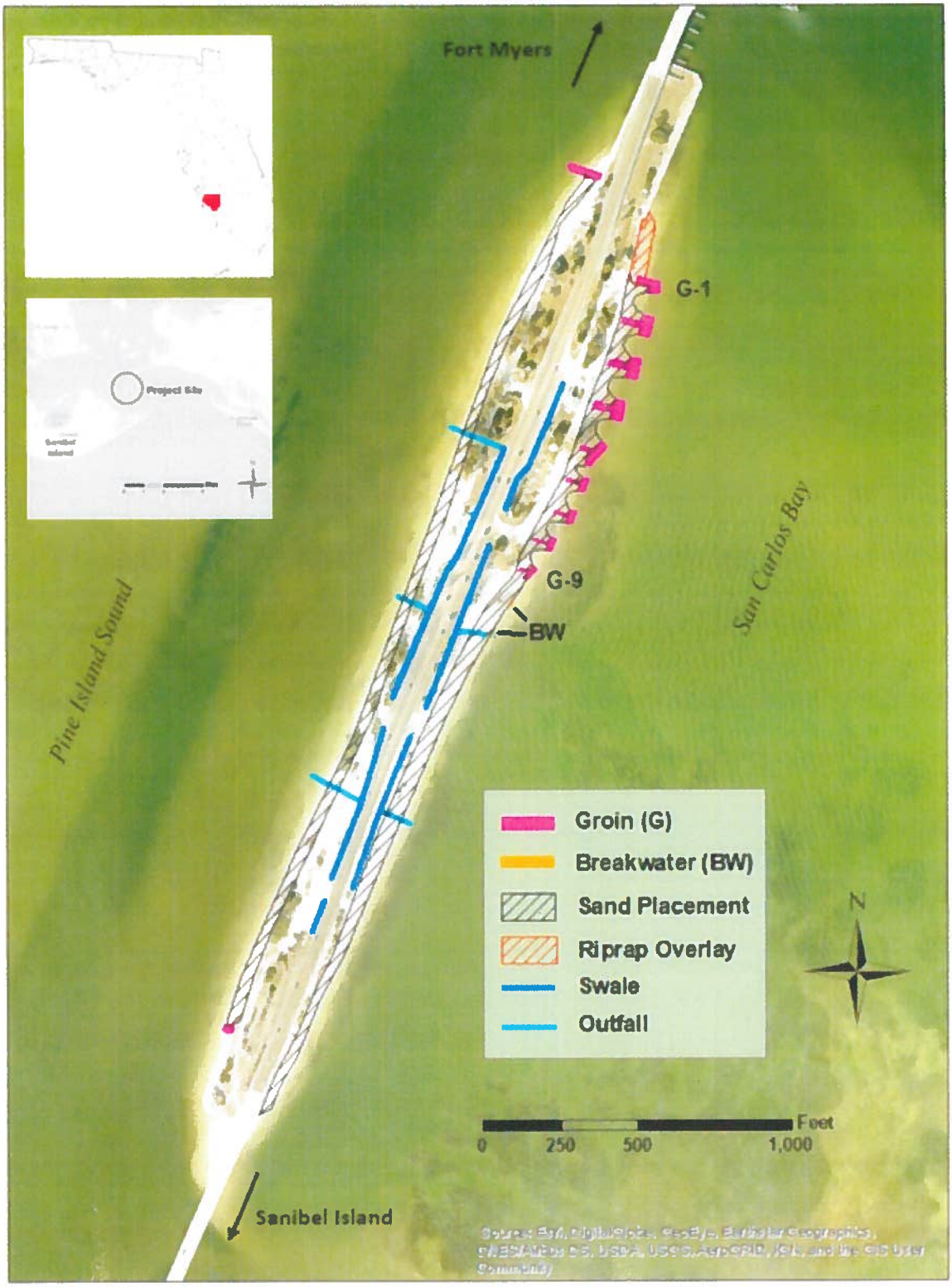

Figure 1. Proposed beach stabilization and stormwater management improvements to Sanibel Island Causeway Island B, Lee County Florida.

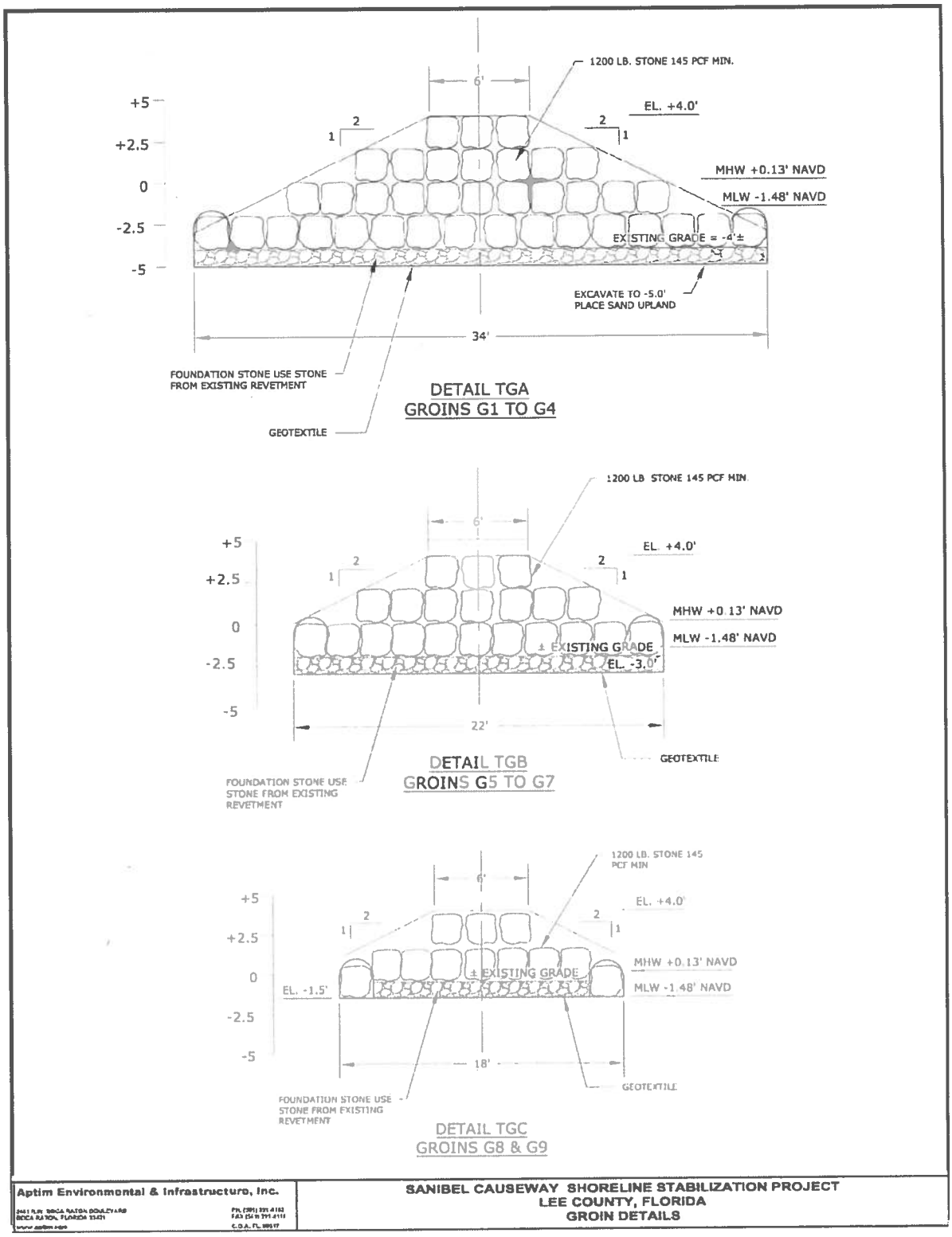

Figure 2. Details for proposed t-groins G1 – G9 along the San Carlos Bay shoreline. (Modified from AE&I, Inc. sheets 10 and 11 of 21 [8/13/2018]).

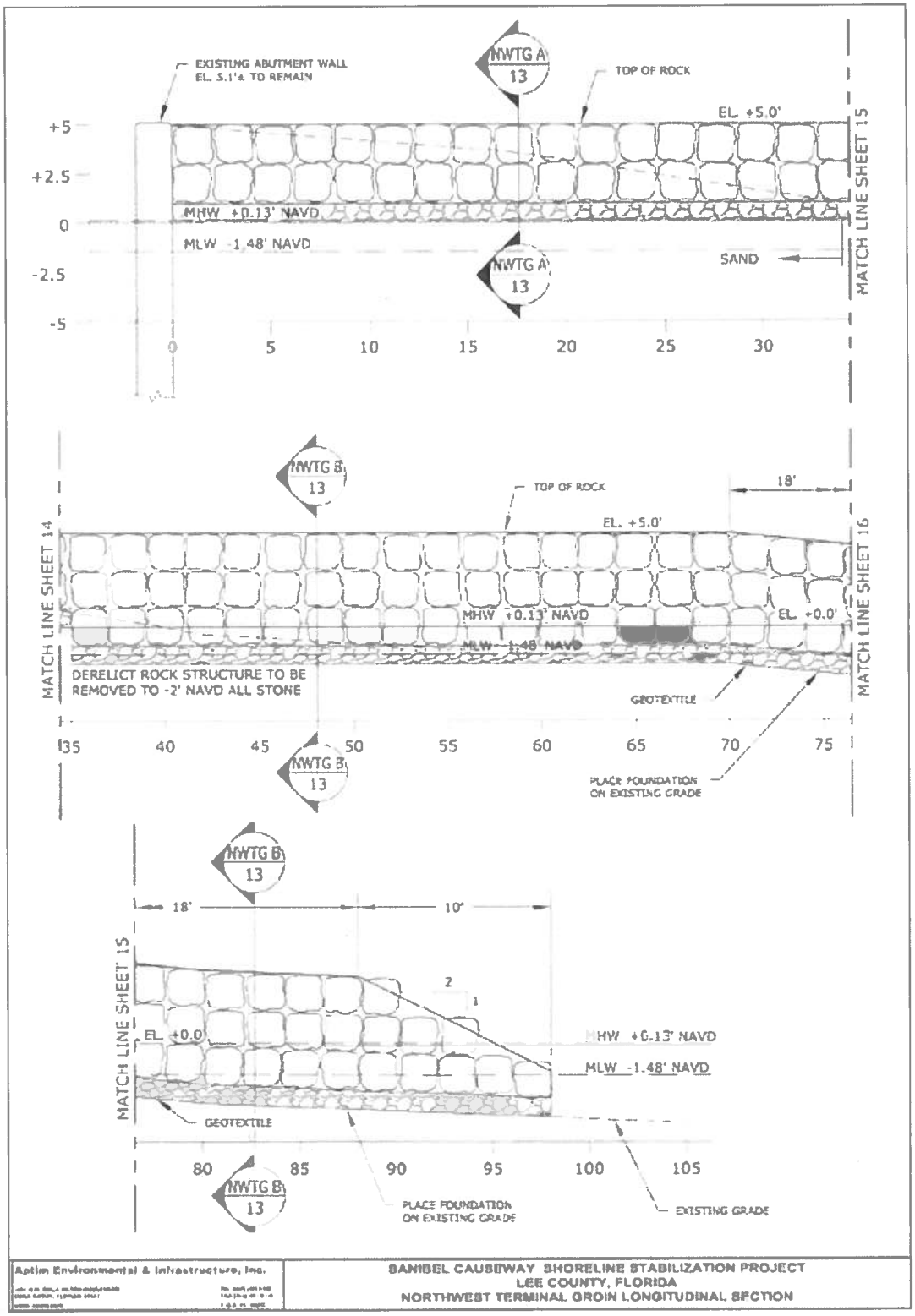

Figure 3. Proposed Sanibel Causeway Island B northwest terminal groin along Pine Island Sound shoreline. (Modified from AE&I, Inc. sheets 14, 15 and 16 of 21 [8/13/2018]).

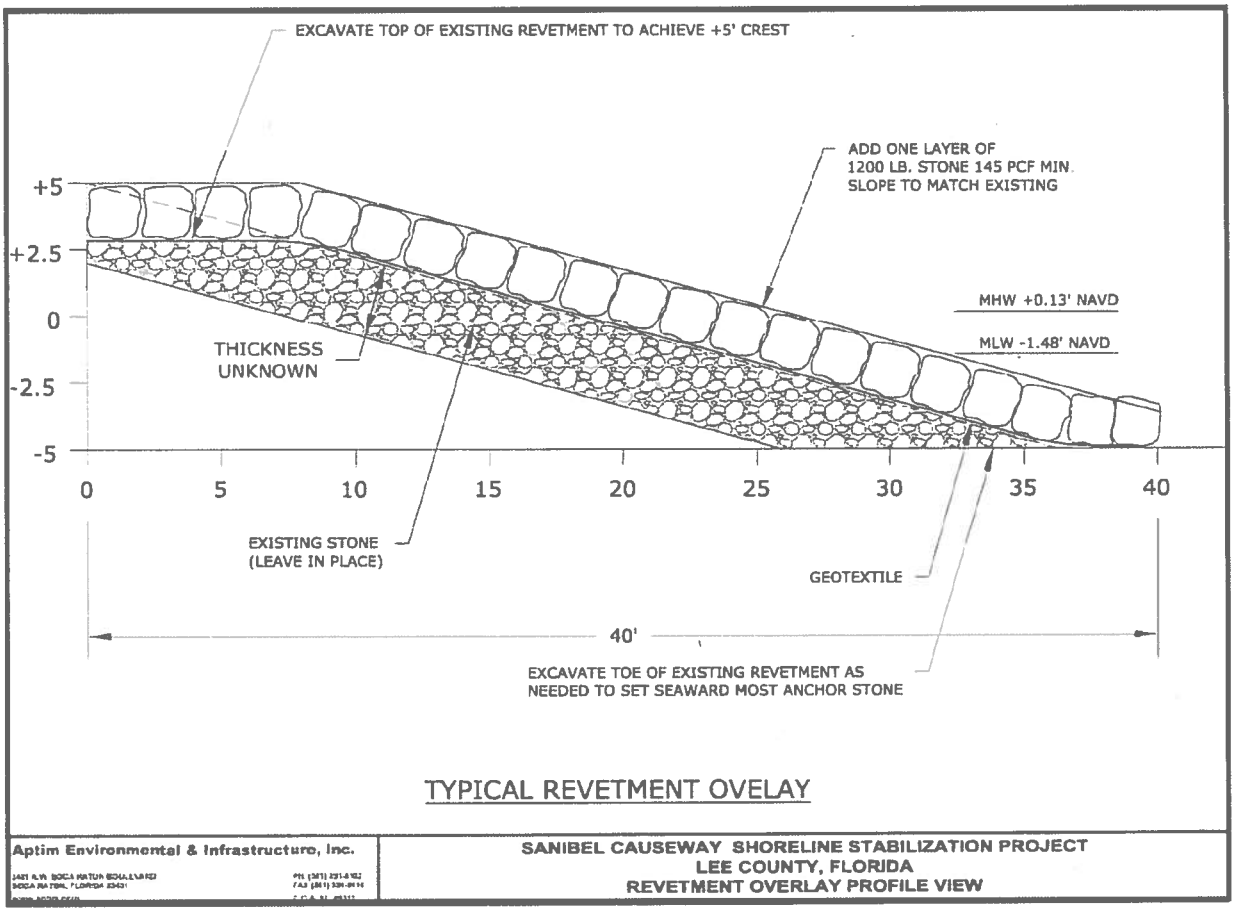

Figure 4. Proposed Sanibel Causeway Island B northeast shoreline revetment overlay along the San Carlos Bay. (Modified from AE&I, Inc. sheet 13 of 21 [8/13/2018]).

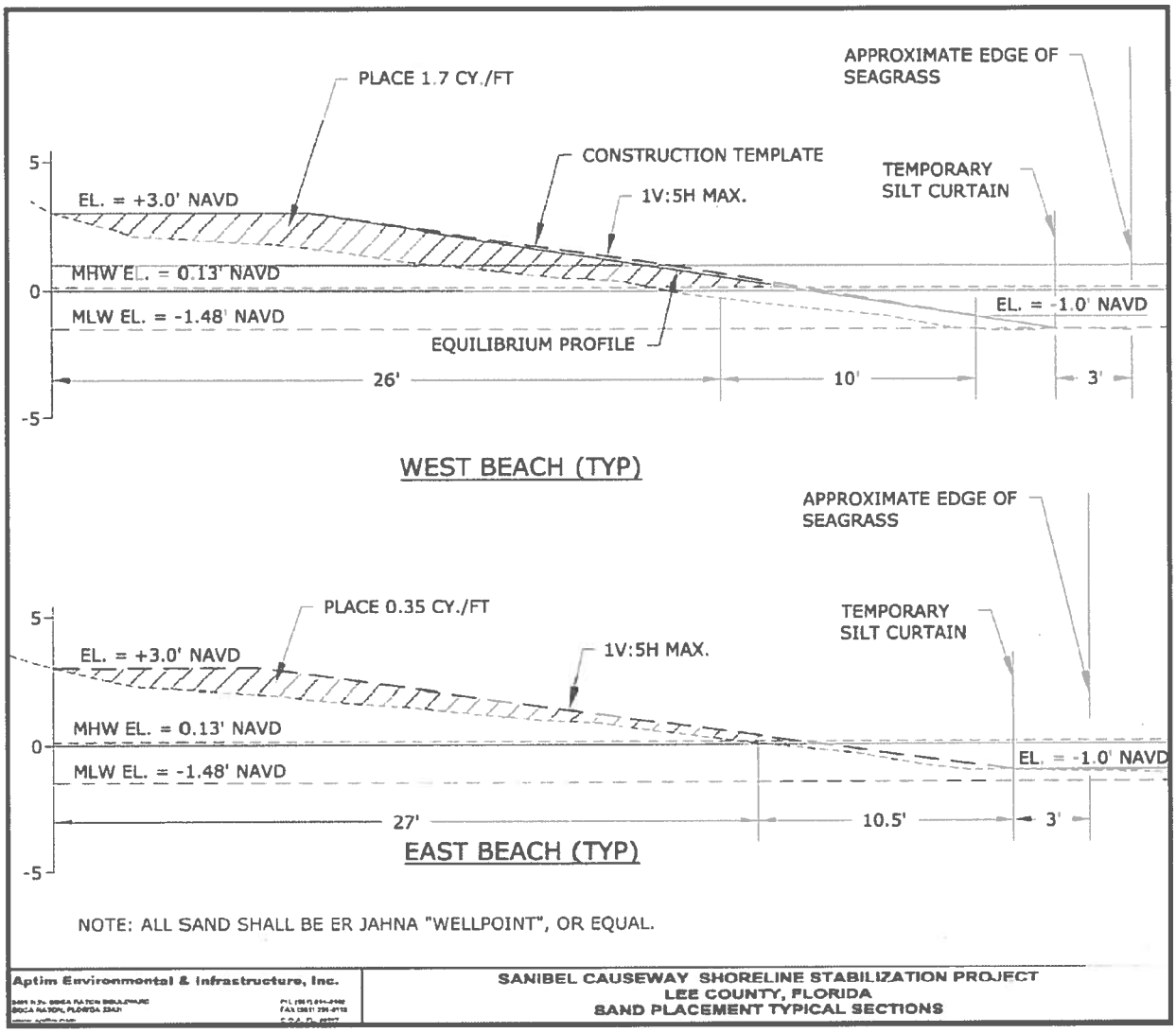

Figure 5. Proposed sand placement for Sanibel Causeway Island B west beach (Pine Island Sound) and east beach (San Carlos Bay). (Modified from AE&I, Inc. sheet 19 of 21 [8/13/2018]).

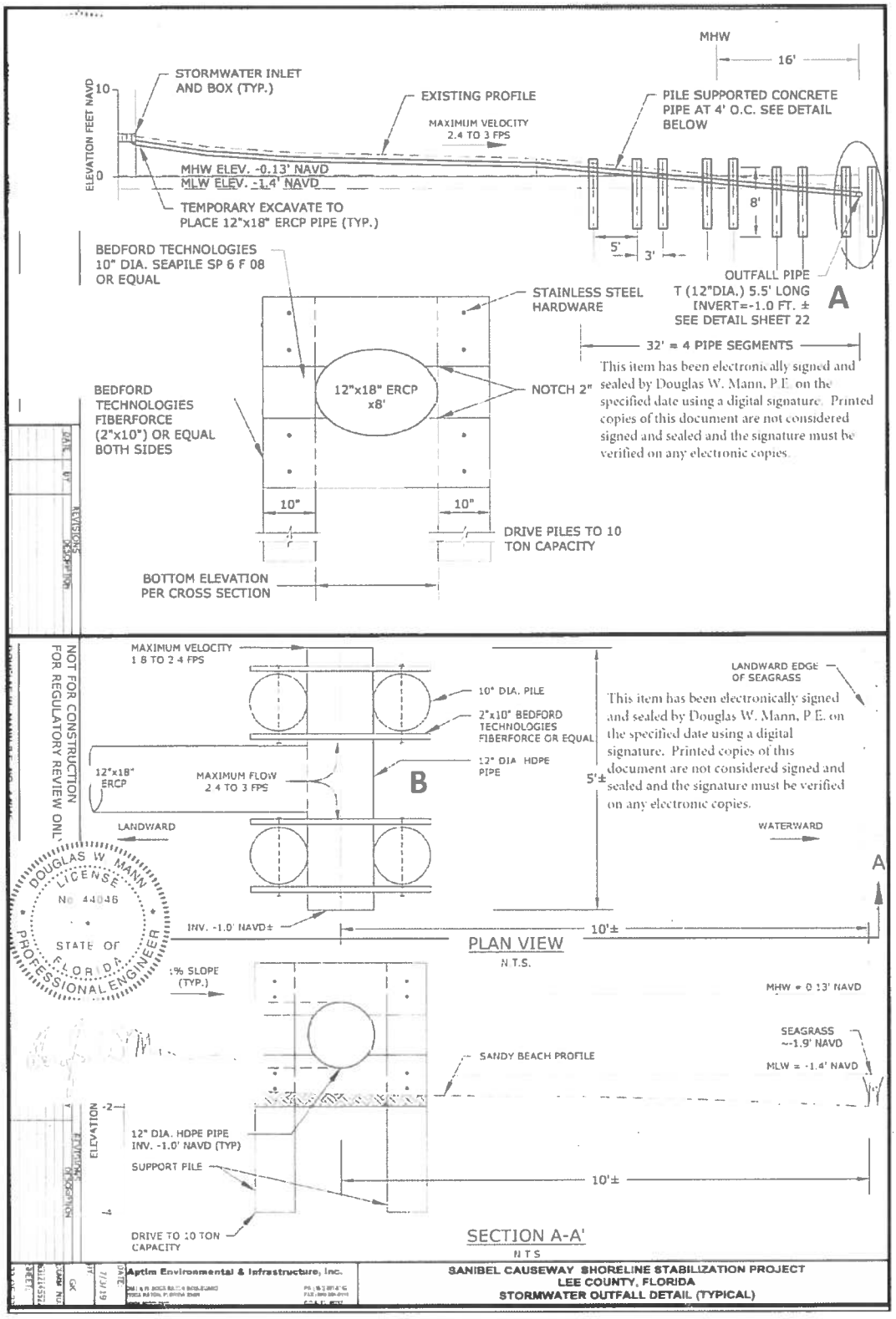

Figure 6. Typical stormwater management system outfall structures (A) and t-pipe modification (B). (Modified from AE&I, Inc. sheets 21 of 21 [8/13/2018; revised 7/3/2019] and 22 of 22 [7/3 2019], respectively).

Appendix A

Sea Turtle Daily Nesting Survey Criteria

CHARACTERISTIC	PARAMETER	MEASUREMENT	VARIABLE
Nesting Success	False crawls - number	Visual assessment of all false crawls	Number and location of false crawls in nourished areas and non-nourished areas: any interaction of turtles with obstructions, such as groins, seawalls, or scarps, should be noted.
	False crawl - type	Categorization of the stage at which nesting was abandoned	Number in each of the following categories: emergence-no digging, preliminary body pit, abandoned egg chamber.
	Nests	Number	The number of sea turtle nests in nourished and non-nourished areas should be noted. If possible, the location of all sea turtle nests must be marked on a project map, and approximate distance to seawalls or scarps measured in meters. Any abnormal cavity morphologies should be reported as well as whether turtle touched groins, seawalls, or scarps during nest excavation.
	Nests	Lost nests	The number of nests lost to inundation or erosion or the number with lost markers.
	Nests	Relocated nests	The number of nests relocated and a map of the relocation area(s). The number of successfully hatched eggs per relocated nest.
	Lighting impacts	Disoriented sea turtles	The number of disoriented hatchlings and adults (Appendix B).

APPENDIX B

ASSESSMENTS: DISCERNING PROBLEMS CAUSED BY ARTIFICIAL LIGHTING

EXCERPT FROM:

UNDERSTANDING, ASSESSING, AND RESOLVING LIGHT-POLLUTION PROBLEMS ON SEA TURTLE NESTING BEACHES

FLORIDA WILDLIFE RESEARCH INSTITUTE TECHNICAL REPORT TR-2

REVISED 2003

LIGHTING INSPECTIONS

WHAT ARE LIGHTING INSPECTIONS?

During a lighting inspection, a complete census is made of the number, types, locations, and custodians of artificial light sources that emit light visible from the beach. The goal of lighting inspections is to locate lighting problems and to identify the property owner, manager, caretaker, or tenant who can modify the lighting or turn it off.

WHICH LIGHTS CAUSE PROBLEMS?

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven to be useful in identifying problem lighting under a variety of conditions:

An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach.

If light can be seen by an observer on the beach, then the light is reaching the beach and can affect sea turtles. If any glowing portion of a luminaire (including the lamp, globe, or reflector) is directly visible from the beach, then this source is likely to be a problem for sea turtles. But light may also reach the beach indirectly by reflecting off buildings or trees that are visible from the beach. Bright or numerous sources, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct glow visible from the beach. This "urban skyglow" is common over brightly lighted areas. Although some indirect lighting may be perceived as nonpoint-source light pollution, contributing light sources can be readily identified and include sources that are poorly directed or are directed upward. Indirect lighting can originate far from the beach.

Although most of the light that sea turtles can detect can also be seen by humans, observers should realize that some sources, particularly those emitting near-ultraviolet and violet light (*e.g.*, bug-zapper lights, white electric-discharge lighting) will appear brighter to sea turtles than to humans. A human is also considerably taller than a hatchling; however, an observer on the dry beach who crouches to the level of a hatchling may miss some lighting that will affect turtles. Because of the way that some lights are partially hidden by the dune, a standing observer is more likely to see light that is visible to hatchlings and nesting turtles in the swash zone.

HOW SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Lighting inspections to identify problem light sources may be conducted either under the purview of a lighting ordinance or independently. In either case, goals and methods should be similar.

GATHER BACKGROUND INFORMATION

Before walking the beach in search of lighting, it is important to identify the boundaries of the area to be inspected. For inspections that are part of lighting ordinance enforcement efforts, the jurisdictional boundaries of the sponsoring local government should be determined. It will help to have a list that includes the name, owner, and address of each property within inspection area so that custodians of problem lighting can be identified. Plat maps or aerial photographs will help surveyors orient themselves on heavily developed beaches.

PRELIMINARY DAYTIME INSPECTIONS

An advantage to conducting lighting inspections during the day is that surveyors will be better able to judge their exact location than they would be able to at night. Preliminary daytime inspections are especially important on beaches that have restricted access at night. Property owners are also more likely to be available during the day than at night to discuss strategies for dealing with problem lighting at their sites.

A disadvantage to daytime inspections is that fixtures that are not directly visible from the beach will be difficult to identify as problems. Moreover, some light sources that can be seen from the beach in daylight may be kept off at night and thus present no problems. For these reasons, daytime inspections are not a substitute for nighttime inspections. Descriptions of light sources identified during daytime inspections should be detailed enough so that anyone can locate the lighting. In addition to a general description of each luminaire (*e.g.,* HPS floodlight directed seaward at top northeast corner of the building at 123 Ocean Street), photographs or sketches of the lighting may be necessary. Descriptions should also include an assessment of how the specific lighting problem can be resolved (*e.g.,* needs turning off; should be redirected 90 degrees to the east). These detailed descriptions will show property owners exactly which luminaries need what remedy.

NIGHTTIME INSPECTIONS

Surveyors orienting themselves on the beach at night will benefit from notes made during daytime surveys. During nighttime lighting inspections, a surveyor walks the length of the nesting beach looking for light from artificial sources. There are two general categories of artificial lighting that observers are likely to detect:

1. **Direct lighting**. A luminaire is considered to be direct lighting if some glowing element of the luminaire (*e.g.,* the globe, lamp [bulb], reflector) is visible to an observer on the beach. A source not visible from one location may be visible from another farther down the beach. When direct lighting is observed, notes should be made of the number, lamp type (discernable by color), style of fixture, mounting (pole, porch, etc.), and location (street address, apartment number, or pole identification number) of the luminaire(s). If exact locations of problem sources were not determined during preliminary daytime surveys, this should be done during daylight soon after the nighttime survey. Photographing light sources (using long exposure times) is often helpful.

2. **Indirect lighting**. A luminaire is considered to be indirect lighting if it is not visible from the beach but illuminates an object (*e.g.*, building, wall, tree) that is visible from the beach. Any object on the dune that appears to glow is probably being lighted by an indirect source. When possible, notes should be made of the number, lamp type, fixture style, and mounting of an indirect-lighting source. Minimally, notes should be taken that would allow a surveyor to find the lighting during a follow-up daytime inspection (for instance, which building wall is illuminated and from what angle?).

WHEN SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Because problem lighting will be most visible on the darkest nights, lighting inspections are ideally conducted when there is no moon visible. Except for a few nights near the time of the full moon, each night of the month has periods when there is no moon visible. Early-evening lighting inspections (probably the time of night most convenient for inspectors) are best conducted during the period of two to 14 days following the full moon. Although most lighting problems will be visible on moonlit nights, some problems, especially those involving indirect lighting, will be difficult to detect on bright nights.

A set of daytime and nighttime lighting inspections before the nesting season and a minimum of three additional nighttime inspections during the nesting-hatching season are recommended. The first set of day and night inspections should take place just before nesting begins. The hope is that managers, tenants, and owners made aware of lighting problems will alter or replace lights before they can affect sea turtles. A follow-up nighttime lighting inspection should be made approximately two weeks after the first inspection so that remaining problems can be identified. During the nesting-hatching season, lighting problems that seemed to have been remedied may reappear because owners have been forgetful or because ownership has changed. For this reason, two midseason lighting inspections are recommended. The first of these should take place approximately two months after the beginning of the nesting season, which is about when hatchlings begin to emerge from nests. To verify that lighting problems have been resolved, another follow-up inspection should be conducted approximately one week after the first midseason inspection.

WHO SHOULD CONDUCT LIGHTING INSPECTIONS?

Although no specific authority is required to conduct lighting inspections, property managers, tenants, and owners are more likely to be receptive if the individual making recommendations represent a recognized conservation group, research consultant, or government agency. When local ordinances regulate beach lighting, local government code-enforcement agents should conduct lighting inspections and contact the public about resolving problems.

WHAT SHOULD BE DONE WITH INFORMATION FROM LIGHTING INSPECTIONS?

Although lighting surveys serve as a way for conservationists to assess the extent of lighting problems on a particular nesting beach, the principal goal of those conducting lighting inspections should be to ensure that lighting problems are resolved. To resolve lighting problems, property managers, tenants, and owners should be given the information they need to make proper alterations to light sources. This information should include details on the location and description of problem lights, as well as on how the lighting problem can be solved. One should also be prepared to discuss the details of how lighting affects sea turtles. Understanding the nature of the problem will motivate people more than simply being told what to do.